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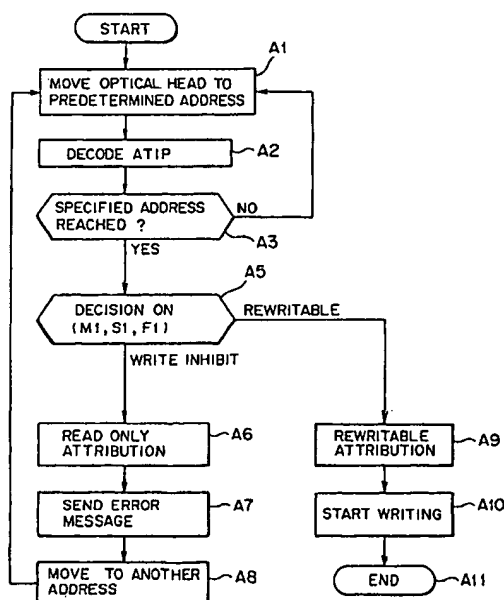
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(54) **REWITABLE PHASE CHANGE OPTICAL DISK PARTLY HAVING ROM REGION AND DATA
RECORDING AND ERASING METHODS FOR OPTICAL DISK**

(57) For an optical recording medium having a phase change type recording layer on its a substrate and having as read only area and a writable area in a recording area, a data recording method is provided which records data in the writable area. This data recording method comprises a transfer step of transferring program data recorded in the read only area in a practical form to an external computer, and an execution step (step A10) of automatically executing the program data in the external computer to record data in the writable area, which can facilitate manufacturing and reduce the possible of destruction or falsification of ROM data.

FIG. 6



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Description

Technical Field

5 [0001] The present invention relates to a rewritable phase change type optical disc including a ROM area partially, and to a system for performing rewrite in a RAM section without inadvertently overwriting ROM data in the disc, and more particularly to a ROM/RAM-mixed rewritable compact disc.

Background Art

10 [0002] In the recent years, optical discs have come into widespread use as a recording medium suitable for distribution, duplicate and retention of a large volume of data. Of these optical discs, a CD-format read only disc (CD-ROM), a recordable disc (CD-R) and a rewritable disc (CD-RW) constitute the most widespread optical disc family. A feature of the CD-ROM, CD-R and CD-RW pertaining to a CD family is an attribution of data thereof, with they being used properly on the basis of the data attributions.

15 [0003] The CD-ROM disc is of a type suitable for use in transferring data onto a substrate in the form of dented pits for duplicating the data with the same contents in large numbers. On the other hand, the CD-R or CD-RW is of a type permitting arbitrary additional recording or rewrite of data, and is thus suitable for data retention or the like at private levels. Of these, the CD-RW has been expected as an inexpensive, large-capacity backup recording medium substituting for floppy discs or MO discs.

20 [0004] A primary difference between a recorded data signal on a CD-RW and a data signal on a conventional CD-ROM (reflectivity of more than approximately 60%) is only that the reflectivity is lower by approximately 15 to 25%, and if the existing drive is designed to handle a low reflectivity, then the compatibility is achievable in a wide range. In fact, many CD-ROM drives have already handled it.

25 [0005] In addition, Japanese Laid-Open (Kokai) No. HEI 11-250522 (which sometimes will be referred to hereinafter as a "well-known document") discloses a technique about a hybrid structure including a non-rewritable aluminum reflection area and a rewritable phase change reflection area. According to the technique disclosed in this well-known document, a non-rewritable recording area, which inhibits rewrite and erase through the use of a dedicated format, is provided in a CD-RW medium while the remaining area is used as a rewritable recording area so that, for read and write, a dedicated CD-RW drive is employed which is capable of restricting write/read by the format dedicated to the non-rewritable recording area.

30 [0006] Still additionally, a large number of drives each capable of recording on both the CD-R and CD-RW media (also capable of rewriting on the CD-RW) have been designed on the basis of the CD-R drive developed prior to the CD-RW, and put on the market.

35 [0007] Rewritable type discs (Partial ROM, P-ROM) having a read only (ROM) area in a section of its information recording area are preferable because of enabling both data distribution and user data recording, and the CD family is likewise required to realize them.

40 [0008] So far, as a write-once type compact disc (CD-R) or rewritable type compact disc (CD-RW), there has been proposed a disc (hybrid disc) in which, through the use of a multisession format, only a first session is used for ROM data while a second session and sessions subsequent thereto are used as a recordable partial ROM area.

[0009] However, for the recording of data in the form of fixed-length packets through the use of a format other than the multisession, there is no rule for when specific packets are employed as a ROM area.

45 [0010] Moreover, in the case of the hybrid disc, since the multisession format prescribed or defined originally for the CD-R is directly used for the CD-RW, considerations are also given to only the recordable function with respect to the second session forming a rewritable (RAM) area and subsequent sessions.

[0011] For this reason, there arises a need to realize a ROM/RAM-mixed disc (Partial ROM, P-ROM disc), which has a ROM area comprising a pre-pits row and freely rewritable RAM area, by the use of the CD-RW.

50 [0012] With such a ROM/RAM-mixed disc, there is a need to read out data from the ROM area and the RAM area without use of separate readout circuits, and there is a need to inhibit substantial distinction from the readout system side.

[0013] Meanwhile, in the recording, the writing in the ROM area is impossible while the recorded data in the RAM area is rewritten by overwrite; therefore, there is a need to distinctively deal with both the data in at least a recording system.

55 [0014] As a conventional example, among magneto-optical discs, there exists a disc having a ROM area comprising a pre-pits row partially. The ROM area is coated as a reflective layer with a recording medium identical to that of the RAM area. However, in the case of the magneto-optical medium, the readout of data originally comprising a pre-pits row involves detection of variation in reflectivity strength while the detection of a magneto-optical signal involving detection of variation in polarization through a complex polarization optical system. That is, since a readout optical system

achieves easy distinction, a characteristic exists that, even if a magneto-optical signal is recorded in a pre-pits row by mistake, this does not affect a signal readout system at all, thus preventing destruction of the ROM data.

[0015] In the meantime, also for a phase change medium, in view of manufacturing, it is also preferable that the ROM/RAM areas have the same multilayer structure. However, since the readout signal from the ROM area comprising a pre-pits row and the readout signal from the RAM area are obtainable through the use of the same optical system, a phase change recorded signal (physically rewritable signal obtainable by a mark row formed on the basis of the difference in property from a peripheral area in a phase change recording layer), by contrast, is overwritten on the pre-pits row to superimpose a RAM recording signal on the pre-pits data, which can destroy the ROM data.

[0016] Currently, although there is an example in which write inhibit is made in units of files on an operating system and the definition of a read only file takes place, the reliability is low because of easy alteration/falsification. No prescription about write inhibit or ROM data attribution exists, as it is, at the logical format level in units of bits or blocks of digital data in lower-order than file attribution.

[0017] In the case of a P-ROM disc using a phase change medium, a recording system is required to recognize a ROM area without depending upon an operating system, or to inhibit rewriting in a recorded area and recognize it as a ROM area thereafter. In particular, a phase change type CD-RW disc, prescribed such that an intended read only compact disc and data format/readout signal are the same in physical characteristics, is required to seize a ROM area and a RAM area in a recording system.

[0018] Among concrete applications for a P-ROM utilizing a phase change medium, there are textbooks for use in repeated practice of languages or music presented in the form of CDs. In such applications, a sentence of a foreign language or a measure of a music, serving as a model (demonstration), is read out as application data to call upon a user to repeat it, and the user immediately records the repeated contents to put them as new input information in a user data area.

[0019] Heretofore, although such an application has been done with a cassette tape, after the demonstration, i.e., readout, a need for complex works exists, such as head search of a tape and switching to readout/recording modes for recording the "repetition". Although there are some cases using a solid-state memory device instead, since limitation is imposed on the recording capacity, difficulty is experienced in dealing with a large volume of demonstration data for a long period of time. In addition, because of the employment of a high-class compression technique to reduce data volume, a delicate nuance, which is said to be necessary for the practice of languages or music, can drop out from the data. With a capacity of 650 to 700 MB like CD-RW, it is possible to accumulate voice data equivalent in quality to that of CD even with almost no compression, or to further increase the voice data volume through the use of a voice compression technique such as MP3.

[0020] The employment of an image compression technique such as JPEG or MPEG1 enables still picture and moving picture demonstrations and recording.

[0021] Meanwhile, in general, the demonstration is divided in units of several seconds to several tens seconds in order to facilitate the repetition, and the recording of the demonstration and user data are required to be made repeatedly within a given time length, so there is a need to shorten the time needed for the switching in recording between the demonstration and the user data to the utmost.

[0022] Accordingly, if an application program is stored on one CD-RW disc and the program and demonstration data are read out therefrom to conduct the demonstrations and user data involving repeated data is then recorded on the same CD-RW disc, this is extremely convenient, for that recording and readout become feasible with the same recording/readout apparatus.

[0023] Moreover, commonly, for such an application, two kinds of data: a main routine comprising an executive program and a demonstration data collection comprising a plurality of contents, are collected as ROM data. For example, here the main routine is such a program as a menu screen appears as an user interface to execute various types of processing according to selection by the user. When the user selects the execution of a specified demonstration in the menu screen, selected data is acquired from the demonstration data collection so that the demonstration is implemented by means of a program of the main routine.

[0024] In this case, if the user updates only the demonstration data collection without changing the main routine, discs for the purpose of small-volume many-kind application distribution are producible with high efficiency. In view of the actual circumstance of computer-aided publishing, an extremely urgent and important requirement is that, instead of a simple CD-ROM, small-volume many-kind application discs are produced as ROM data capable of updating partially.

[0025] It is an object of the present invention to provide a P-ROM, data recording method, data readout method and data erase method easy to produce and providing less possibility of destruction or falsification of ROM data, and more particularly to provide an optical recording medium, data recording method for rewritable phase change type optical disc, data erase method for rewritable compact disc, data erase method for rewritable phase change type recording medium, read only data erase method, and recording/readout apparatus.

[0026] More concretely, the present invention relates to a rewritable compact disc having both a read only area and

rewritable area.

Disclosure of Invention

5 [0027] For the foregoing purpose, in accordance with a first point of the present invention, there is provided an optical recording medium comprising a substrate having a phase change type recording layer, and having a read only area and a rewritable area in its information recording area, wherein the read only area and the rewritable area have the same multilayer structure, and data and address information in the read only area and the rewritable area comprise basic data units having the same logical structure, and auxiliary data capable of distinguishing between read only data and rewritable data is provided in the unit or in a data unit including a plurality of data units each corresponding to the unit.

10 [0028] Accordingly, this enables handling intended rewriting data as logical ROM data. Moreover, for example, a CD-RW is apparently used as a write-once type medium.

[0029] In addition, in accordance with a second point of the present invention, in the arrangement of the optical recording medium according to the above-mentioned first point, an address to be added to the basic data unit and the auxiliary data are written previously on the substrate in the rewritable area and the read only area.

15 [0030] Still additionally, in accordance with a third point of the present invention, in the arrangement of the optical recording medium according to the above-mentioned first or second point, information in the read only area is obtained by a plurality of pre-pits rows made on the substrate.

[0031] Moreover, in accordance with a fourth point of the present invention, in the arrangement of the optical recording medium according to the aforesaid second point or third point, a groove is formed in the rewritable area to have a wobble made so that a center line thereof shows a predetermined amplitude with respect to a recording/readout optical beam scanning direction, while a center line of a pre-pits row in the read only area wobbles to show an amplitude substantially equal to the amplitude of the groove with respect to the optical beam scanning direction, and consecutive address information is given by the wobble of the groove and the wobble of the center line of the pre-pits row.

25 [0032] Still moreover, in accordance with a fifth point of the present invention, in the arrangement of the optical recording medium according to the aforesaid fourth point, a carrier frequency due to the wobble of the groove and the wobble of the center line of the pre-pits row is frequency-modulated or phase-modulated with digital information to provide auxiliary data.

[0033] Accordingly, with this arrangement, in a P-ROM disc in which a physical ROM area comprising pre-pits or the aforesaid logical ROM area and a RAM area are formed in a mixed state and they are covered with a phase change medium, it is possible to overwrite the ROM data, thus preventing the destruction and falsification of the ROM data.

30 [0034] In addition, in accordance with a sixth point of the present invention, in the optical recording medium according to the aforesaid first point, information in the read only area is acquired by a mark row formed on the basis of a difference in optical characteristics from a peripheral area in a phase change recording layer, and write inhibiting processing is conducted with respect to the mark row.

35 [0035] Thus, a rewritable area with a write-once (first-time writable) attribution is distributed to a user in a non-recorded state so that the user receives it as a pseudo write-once medium which permits write-once (first-time writable).

[0036] Still additionally, in accordance with a seventh point of the present invention, in the arrangements of the optical recording media according to the aforesaid first to sixth points, fixed-length data is used as the basic data unit containing the auxiliary data.

40 [0037] Thus, it is possible to surely provide a data attribution representative of whether it is "rewritable" or "read only", at a lower level in a recording/readout drive unit.

[0038] Moreover, in accordance with an eighth point of the present invention, in the arrangements of the optical recording media according to the aforesaid first to seventh points, data in an information recording area is an eight to fourteen modulation signal (EFM signal) compatible with a compact disc.

45 [0039] Still moreover, in accordance with a ninth point of the present invention, in the arrangement of the optical recording medium, a prescription on the rewritable attribution or the read only attribution is placed in an absolute time in pre-groove (ATIP) frame.

[0040] Furthermore, in accordance with a tenth point of the present invention, in the arrangement of the optical recording medium according to the aforesaid ninth point, ATIP information is stated in terms of an absolute time of a two-digits BCD code in units of minutes, seconds or frames, and when the most significant bits in eight bits for expression of the minute, second and frame are respectively taken as M1, S1 and F1, the attribution is prescribed in a state associated with any one of (0, 0, 0), (0, 0, 1), (0, 1, 0) and (0, 1, 1) of (M1, S1, F1) in a program area.

50 [0041] Still furthermore, in accordance with an eleventh point of the present invention, in the arrangement of the optical recording medium according to the aforesaid eighth point, a prescription on the rewritable attribution or the read only attribution is placed in an EFM frame.

55 [0042] Yet furthermore, in accordance with a twelfth point of the present invention, in the arrangement of the optical recording medium according to the eleventh point, the attribution of a frame specified by the subcode is prescribed in

a state associated with specific two bits in a Q-channel of the subcode.

[0043] In addition, in accordance with a thirteenth point of the present invention, in the arrangement of the optical recording medium according to the eighth point, a prescription on the rewritable attribution or the read only attribution is placed in a block.

5 [0044] Still additionally, in accordance with a fourteenth point of the present invention, in the arrangement of the optical recording medium according to the thirteenth point, the attribution of the block is prescribed in a state associated with specific two bits in a plurality of bits describing mode information included in a header of the block.

[0045] Moreover, in accordance with a fifteenth point of the present invention, in the arrangements of the optical recording media according to the first to fourteenth points, the attribution on whether or not to be rewritable includes an attribution on whether or not to be rewritable only one time and an attribution on whether or not to be writable repeatedly.

10 [0046] Still moreover, in accordance with a sixteenth point of the present invention, in the arrangements of the optical recording media according to the eighth to fifteenth points, a program area is divided into a plurality of sessions according to a prescription of a multisession format so that some of divided sessions are used for read only while the other sessions are made rewritable.

15 [0047] Yet moreover, in accordance with a seventeenth point of the present invention, in the arrangement of the optical recording medium according to the sixteenth point, the program area is divided into a first session comprising read only data having an ISO9660 file structure and a second session comprising a rewritable type area so that user data and lead-out in the first session are handled as read only data while a lead-in area, a program memory area (PMA) and a power calibration area (PCA) are made rewritable.

20 [0048] Furthermore, in accordance with an eighteenth point of the present invention, in the arrangement of the optical recording medium according to the sixteenth point or seventeenth point, information representative of whether the session pertains to the rewritable attribution or the read only attribution is included in a lead-in area of each session of the multisession format.

25 [0049] Still furthermore, in accordance with a nineteenth point of the present invention, in the arrangement of the optical recording medium according to the eighteenth point, information representative of an optical recording medium having a read only area and a rewritable area is included in special information of the lead-in area or the lead-in area of the first session of the multisession format stated with ATIP.

30 [0050] Yet furthermore, in accordance with a twentieth point of the present invention, in the arrangement of the optical recording medium according to the eighth to eighteenth points, information representative of an optical recording medium having a read only area and a rewritable area is included in EFM data of the lead-in area or the lead-in area of the first session of the multisession format.

35 [0051] Accordingly, with this arrangement, three types of data areas of a master ROM, a post ROM and a RAM can be formed in a state mixed on the same disc. In addition, owing to the ATIP, a rewritable area having a write-once attribution is usable as a pseudo write-once medium on the user side, and the master ROM area is producible on the user side.

[0052] In addition, in accordance with a twenty-first point of the present invention, there is provided a data recording method for use in a rewritable phase change type optical disc which has a phase change type recording layer on its substrate and which has a read only area and a rewritable area in its information recording area, comprising of a transfer step of transferring program data recorded in the read only area in a practicable form to an external computer and an execution step of automatically executing the program data in the external computer to record data in the rewritable area.

[0053] Thus, this enables conducting doubled write inhibiting processing on the system, thus enhancing the reliability about the ROM data destruction prevention, besides the complete compatibility with the existing formats is achievable.

45 [0054] Still additionally, in accordance with a twenty-second point of the present invention, in the arrangement of the optical recording medium according to the foregoing first point, identification information representative of a rewritable type including a partial read only area is written previously on the substrate in the form of pre-pits or a wobble.

[0055] Moreover, in accordance with a twenty-third point of the present invention, in the arrangement of the optical recording medium according to the foregoing twenty-second point, data in the read only area comprises a pre-pits row, and address information in the read only area, together with the identification information, is written previously on the substrate in the form of pre-pits or a wobble, and further file management information on a file included in the read only area and the rewritable area is written in the rewritable area.

55 [0056] Thus, this enables recognizing that, when a disc is inserted into a recording drive, it is a P-ROM disc, and acquiring file management information about the ROM area to save it in a memory on the system. In addition, it is possible to prevent only the file management information from being erased or the disc from being initialized due to overwrite in error to make the access to the ROM area difficult, or to prevent the ROM data from being destroyed by the overwrite without recognizing the presence of the ROM area. Still additionally, the ROM data comprising a pre-pits row is erasable by overwriting different data from the ROM data in the phase change type recording layer in the read

only area having the ROM data, so the factory or software manufacturer side, for example, can certainly keep data, undesirable to show to the user side, in secret.

[0057] Still moreover, in accordance with a twenty-fourth point of the present invention, there is provided a data erase method for use in a rewritable phase change type recording comprising a substrate medium having a phase change type recording layer, and having a read only area and a rewritable area in its information recording area, comprising a recognition step of recognizing identification information previously written in the form of pre-pits or a wobble on the substrate and representative of that the recording medium is of a rewritable type including a read only area comprising partially a pre-pits row or wobble, a memory transfer step of acquiring address information from the read only area for transferring the address information to a storage unit, an erase step of erasing file management information written in a file management area of the recording medium, and a re-recording step of recording, the address information of the read only area, transferred to the storage unit, into the file management area.

[0058] Yet moreover, a twenty-fifth point of the present invention has an arrangement comprising an identification step of identifying, on the basis of information recorded in a lead-in area of the first session area in a compact disc with a multisession format having a plurality of session areas each including a lead-in area, that the compact disc is of a rewritable type having a read only area, an extraction step of extracting an attribution about rewrite, write-once (first-time writable) or write inhibit (read only) from each of the lead-in areas of the plurality of session areas, a memory transfer step of, when the attribution extracted in the extraction step is about the write inhibit (read only), transferring a file structure of the write inhibit (read only) session area to a storage unit, an erase step of erasing information recorded in the lead-in area of the first session area, and a re-recording step of recording the disc identification information, the file structure of the write inhibit session area transferred to the storage unit and a leading address of a rewritable area.

[0059] Thus, this enables avoiding the erase of ROM data due to direct overwrite, and further preventing the erase of the ROM data stemming from the failure of a simple erase operation.

[0060] Furthermore, in accordance with a twenty-sixth point of the present invention, in the arrangements of the optical recording media having a partial read only area, according to the foregoing first to twentieth, twenty-second and twenty-third points, has the read only area including a first read only area in which data is recorded in the form of a pre-pits row and a second read only area formed by inhibiting re-write after recording of data and has the rewritable area.

[0061] Still furthermore, in accordance with a twenty-seventh point of the present invention, in the arrangement of the optical recording medium according to the foregoing twenty-second point, a predetermined updating-unnecessary application program is stored in the first read only area, and an updating-possible or customized application program is stored in the second read only area, and further a user data recording area capable of recording user data related to at least the application program is provided in the rewritable area.

[0062] Thus, this enables ROM data to be impossible to be falsified, erased and destroyed, and making at least a recording drive seize a ROM area.

[0063] Yet furthermore, in accordance with a twenty-eighth point of the present invention, there is provided a recording/readout apparatus in which an application program area containing data of a predetermined application program is formed as a read only area with a read only attribution in specified consecutive areas existing in a program area and a user data recording area capable of recording user data related to at least the application program is set as a rewritable area with a rewritable attribution in the remaining program area of the specified consecutive areas and which is made to read out the application program and record/read out the user data related to the application program, the apparatus comprising recognition means for, when a medium is mounted, recognizing that it is a rewritable phase change type optical disc having a partial read only area partially, program execution means capable of gaining access to the read only area recognized by the recognition means to acquire the application program data for executing the contents of the program, information input means capable of inputting required information in accordance with the application program executed by the program execution means, and recording means capable of gaining access to the user data recording area to record, as user data, the information inputted by the information input means.

[0064] With this arrangement, in addition to, for example, language practice, it is possible to store a first-version application program in a master ROM area and store only a portion, needed for correction of the program, in a post ROM area when a need for a partial version-up of the program exists.

[0065] Moreover, in accordance with a twenty-ninth point of the present invention, there is provided a read only data erase method for use in an optical recording medium in which a phase change type recording layer is formed on a substrate and read only data is made by a plurality of pre-pits rows formed on the substrate, wherein data different from the read only data is overwritten in the phase change type recording layer for making impossible the readout of the read only data.

[0066] Thus, this enables the factory or software manufacturer side, for example, to erase a portion of data to be updated in a master ROM area.